

Oil Palm

Botanical name: *Elaeis guineensis*.

Family: Arecaceae.

Origin: The oil palm is originated from West Africa.

Importance

Oil palm is the highest oil producer among perennial oil yielding crops. It produces two distinct oils viz, palm oil (extracted from mesocarp of fresh fruits) and palm kernel oil (from kernel). Palm oil has excellent health attributes. It is rich in vitamins A, E and is cholesterol free. It can be used in manufacture of biscuits, ice creams, soaps, detergents and shampoos and also as frying fat. Palm kernel oil has variety of industrial uses .

Variety

Broadly, there are three Indian varieties viz. Dura, Piscifera and Tenera .

Climate

- Oil palm requires a well distributed rainfall of 2500 to 4000 mm per annum.
- Minimum temperature ranges from 22°C to 24°C.
- Maximum temperature ranges from 20°C to 33°C.
- Oil palms require at least 5 to 6 hours of bright sunshine per day for growth.
- 80% of humidity for optimum growth.

Soil

Deep, well drained medium loam soil, rich in humus is the most suitable for oil palm cultivation. Optimum soil reaction is from pH 6.5 to 7.5.

Land Preparation

Land should be made weed free and 2 ploughings should be given to get the soil fine tilth stage. Supplement the field with good organic matter to make the soil rich field.

Propagation

The Propagation in oil palm cultivation is mainly by seeds and seeds are extracted from fruits using depericarper. Pre-heating of seeds is required for 75 days at 40°C temperature due to their high dormancy. Thereafter, seeds should be soaked in running water and make them to cool down for 4 to 5 days. The seeds start germinating if 10 to 12 days and once germinated, sprouts should be transplanted to poly bags.

In nursery raising, the single stage poly bag system is a very popular propagation method and in this

process, a poly bag should be filled with top soil, sand and well rotten manure. Then sprouts should be placed at a depth of 2.5 cm in the center of the poly bag. Regular watering and mulching should be carried for proper growth of seedlings. Use recommended NPK in nursery until they are transferred to the main field.

Planting and Spacing

Oil palm is planted in triangular system at a spacing of 9 X 9 X 9 m accommodating 143 plants in a hectare. Planting should be done in the pits with size of 60 cm X 60 cm X 60 cm. Planting can be done in any season .

Time of planting

However, the best period is June to December. Seedlings of 10-14 months age are best suited for planting.

Fertilizer Application

The following fertilizer dosage (kg/palm/year) is recommended for oil palm cultivation.

Year	FYM	Urea	SSP	MoP	MgSO₄
1	50	0.87	1.25	0.66	0.12
2	50	1.74	2.50	1.33	0.25
3	50	2.61	3.75	2.00	0.50
4	50	3.00	5.00	4.00	0.50

Fertilizers are preferably applied in 3- 4 split doses. Application of green leaf manure or compost is advantageous, especially where the soils are poor in organic matter.

Intercultural operation

Weed Control: Regular manual weeding or chemical weeding can be carried out in oil palm cultivation. However, chemical weeding should be done only with recommended herbicides. For effective control of weeds, Glyphosate of 700-750 ml/ha/year or 17 ml/basin should be applied. By spraying herbicide mixtures of Paraquat with Atrazine, Diuron and Monuron on ground can effectively control the weeds and this operation should be carried out twice a year.

Mulching: Mulching can be carried out to conserve the soil moisture and control the weed growth. Mulching can be done with dried leaves, coconut husk, male flowers and empty bunches.

Irrigation

Oil palm requires adequate irrigation, as it is a fast growing crop with high productivity and biomass production. For yielding palms of above 3 years age, a minimum of 150 litres per day is required. In older plantations the requirement goes upto 20 litres per day.

▲ The crop responds well to drip or micro sprinkler irrigation particularly when water is limited.

- ▲ If drip is installed four drippers have to be placed for each palm.
- ▲ If each dripper discharges 8 litre per hour, 4-5 hour of irrigation is sufficient to discharge 160 litre per day.
- ▲ Drip irrigation increases the productivity by 15-20 percent, reduces wastage of water and requires less power / fuel per irrigation compared to conventional irrigation methods.
- ▲ It is important to note that any physiological stress shifts sex ratio in favour of male flowers and consequently the productivity is reduced.

Inter crop

During the initial stages of plantation in oil palm i.e. upto 3rd year, some of the light feeder inter crops such as pulses, cereals, vegetables, grasses etc can be grown. Inter crop should be grown 1m away from the basin in 1st year of oil palm plantation. In two year old plantations, it should be grown 2m away, followed by 3m in the third year plantations.

Basin Management

As part of the basin management practice in the oil palm cultivation, basins of 1 meter radius, second year 2 meter radius, and the third year 3 meter radius should be made by removing the soil inside so that soil accumulation can be prevented in the collar region of the palm. For healthy roots, basins should be weed free and clean.

Pollination

The oil palm is a highly cross-pollinated crop in which the insects and wind assist pollination. However, wind pollination is not sufficient and the insects like “*Elaeidobius kamerunicus*” assists in good fruit set and effective pollination. This weevil should be released after two and half year of planting and in case of low vigour and girth plantation, releasing the weevils after three years is advisable.

Disease and insect

- Insects: Rhinoceros beetle and Slug caterpillar, Mealy bugs etc.
- Diseases: Stem rot, Bud rot, Crown disease, Morasmus disease for fruit bunches and Gramodenus fungus, Pestalotiopsis leaf spot, Oil palm wilt etc.

Control

1. a) To control Rhinoceros beetle remove the adult beetles from the infected plants and fill the hole with a mixture of BHC 10% or DDT 10% and fine sand (1:1).

(b) Treat the breeding ground with 50% BHC or Carbaryl 50% at 350 g/3m³.
2. To control the stem rot, prune the diseased frontals and burn them.

3. To control Morasmus disease, remove the unpollinated branches when they show signs of decay and burn them.
4. Gramodenues can be controlled by removing severely affected palms along with roots from the garden. Apply 1 kg Mancozeb or Captan or Thiram in Deep trenches, 1m away from base of the palms.
5. To control the damages of Slug caterpillar, remove and burn affected leaflets and spray the plants with 40 g Carbaryl in 10 litres of water.

Harvesting

The oil palms will be ready for harvesting in 2.5 to 3 years after the plantation in the main field. Determining harvesting time is very important in oil palm cultivation as it greatly impacts the quality and quantity of oil. Harvesting can be done when the fruits on palm turn into yellowish–orange colour and 5 to 8 fruits drop on their own. The final check would be when pressing the fruits hard with finger, orange coloured oil should extrude from the palm fruits.

Harvesting takes place throughout the year and generally done in 10 to 14 days interval with the help of sharp knife or sickle. A stalk length of 5 cm should be left while harvesting the fruit bunches.

Yield

Oil palm starts bearing from 4th year onwards and its economic life varies from 30 to 35 years . The yield of oil palm varies according to age and management . Under average management conditions in a mature plantation (8 to 9 years old), yield of 15-18 tonnes of fresh fruit bunches (FFBs) per hectare is expected. Under good maintenance and management, yield upto 25 - 30 tonnes of FFBs per hectare is possible.

Cocoa

Botanical Name: *Theobroma cacao*.

Family: Sterauliaceae.

Origin: It originated in Central America and parts of Mexico.

Importance

The main uses of cocoa are food, medicinal/therapeutic, cosmetics, peat mulch alternative.

- Cocoa aids in lowering blood pressure (BP) and improving the elasticity of blood vessels.
- Cocoa beans have excellent antioxidant properties.

- Cocoa is good for brain health.
- Cocoa lowers blood cholesterol (Lowers TGCL and LDL).
- Cocoa prevents from neuro-degenerative disorders.
- Cocoa aids in bronchial asthma patients.
- Cocoa helps in fighting with obesity.
- Copper deficiency and Magnesium deficiency can be prevented from cocoa consumption.
- Cocoa prevents chronic fatigue syndrome (CFS).
- Cocoa is good for skin.

Variety

◆ Forastero variety: CCRP– 1, CCRP– 2, CCRP– 3, CCRP– 4, CCRP– 5, CCRP– 6, CCRP– 7.

◆ Hybrid: VTLCH1, VTLCH2, VTLCH3 and VTLCH4CCRP– 8, CCRP– 9, CCRP– 10.

Climate

- Cocoa bean trees can be cultivated at altitudes up to 1150 meters above mean sea level (MSL).
- Cocoa crop requires an average annual rainfall of 1000 mm to 2000 mm.
- Relative humidity of 80-85%.
- The maximum temperatures required for its cultivation are 34°C.
- The minimum temperatures required for its cultivation 14°C.

Soil

Cocoa trees can be grown wide range of soils. Cocoa trees are predominantly cultivated in red laterite soils. However, these trees prefer well-drained clay, loam or sandy loam soil with pH range of 6.5 to 7.0. Water retaining soils are best for its optimum growth and yield.

Propagation

Propagation of cocoa is done through seeds and vegetative cuttings.

Seed propagation: In seed propagation of cocoa, seeds should be treated with ash or lime. Cocoa seeds should be sown polythene bags. These seeds can be raised in nursery beds with required shade. Seeds sown soon after extraction. Seedlings of 60 cm height should be ready for transplantation in main filed. For better germination, make sure to sow the seeds whose pod husk thickness is less than one centimeter and bean (dry) weight is more than one gram.

Vegetative Propagation: Cocoa trees may propagated by vegetative cutting, budding, grafting. In vegetative propagation to achieve 90% of rooting, should use cuttings of 3 to 4 cm long with 1 or 2 leaves on it treated with IBA and planted in medium of rotten palm fiber and sand in equal part.

Generally tree cuttings of 15 cm length bearing four terminal leaves should be treated with NNA + IBA dip and planted in poly bags, this will result in rooting of 65 to 75% after one month.

Land Preparation

Land should be prepared by giving 3 to 4 ploughings until the soil attains fine tilth stage. As this crop requires well-drainage soil, land should be prepared in such a way that the water should be drained quickly.

Planting and Spacing

Cocoa plantation depends on cultivar and method adopted. However, the following shows the recommended spacing when the cocoa is grown as intercrop. Basically, cocoa is a shade loving plant and natural or artificial shade should be created during its seedling period and growing period. Cocoa requires more shade initial stages than later stages of growth.

Main Crop	Inter Crop	Spacing (m)	Cocoa Plant/ ha
Coconut	Cocoa	7.5 X 7.5	500
Arecanut	Cocoa	2.7 X 2.7	686
Oil palm	Cocoa	4.5 X 4.5	400

Selection of planting materials

When seedlings are used as planting, select vigorous and healthy seedlings from polyclonal garden. The planting material should be of 4-6 month old seedling or grafted or budded plant. The seedling/grafted/budded plant should be planted in the centre of the pit, not too deep. While planting grafts, polythene strip tied over graft joint should be removed and the joint should be above the soil.

Manures and Fertilizers

Cocoa plant responds very well to organic manures and fertilizers. Any nutrient/micro-nutrient gaps should be filled during soil/land preparation.

On an average, each cocoa plant requires-

▲ FYM: 8 to 10 kg/ year.

▲ P₂O₅ : 40 g/ year.

▲ N: 100 g/ year.

▲ K₂O: 140 g/ year.

These fertilizers should be applied in 2 equal split doses; one in April–May other in August–September. Organic manures should be applied in first year itself. 1/3 of fertilizers in first year, 2/3 in second year and full dose should be applied from third year.

Pruning

Pruning is the process of thinning of branches and removing old or dead stems/branches. This is mandatory in most of the farm management to allow the crop to grow well by allowing direct sunlight. Pruning in cocoa cultivation should be carried out twice a year. Pruning is done to encourage a tree structure or control the height that allows sunlight.

♣ Carry out the first pruning after main harvest just before monsoon.

♣ Second pruning should be done 6 months after the first one.

Any lower branches and dead branches should be removed. Limit the branches 4 to 5 for better sun light. Burn any diseases branches after they are removed.

Irrigation

Proper irrigation of cocoa plants ensures healthy growth and yield. Constant moisture should be maintained as cocoa plants are sensitive to drought. Young cocoa plants should be irrigated frequently at an interval of 3 days during summer and hot/dry climatic conditions. It does not require any watering in rainy season. In case of floods and over rains, make sure to drain out the water from fields as soon as possible. Adopting drip irrigation is best method of using water effectively. Even applying fertilizers through drip is possible for better utilization of fertilizers and controlling weed growth.

Pests and Disease

In any crop, pest and disease control play major role for getting quality produce and higher yields. The following are the main pests and diseases found in cocoa cultivation-

Pests: The following are common pests found in cocoa cultivation- Mealy bugs, Aphids, Plant hoppers, Caterpillars, Mosquitoes, Cocoa pod borer and Stem Girdlers.

Diseases: The following are common diseases found in cocoa cultivation- Cocoa swollen shoot, Seedling blight, Witches broom, Black Pod, Frosty pod, Stem Canker and Wilt.

Control

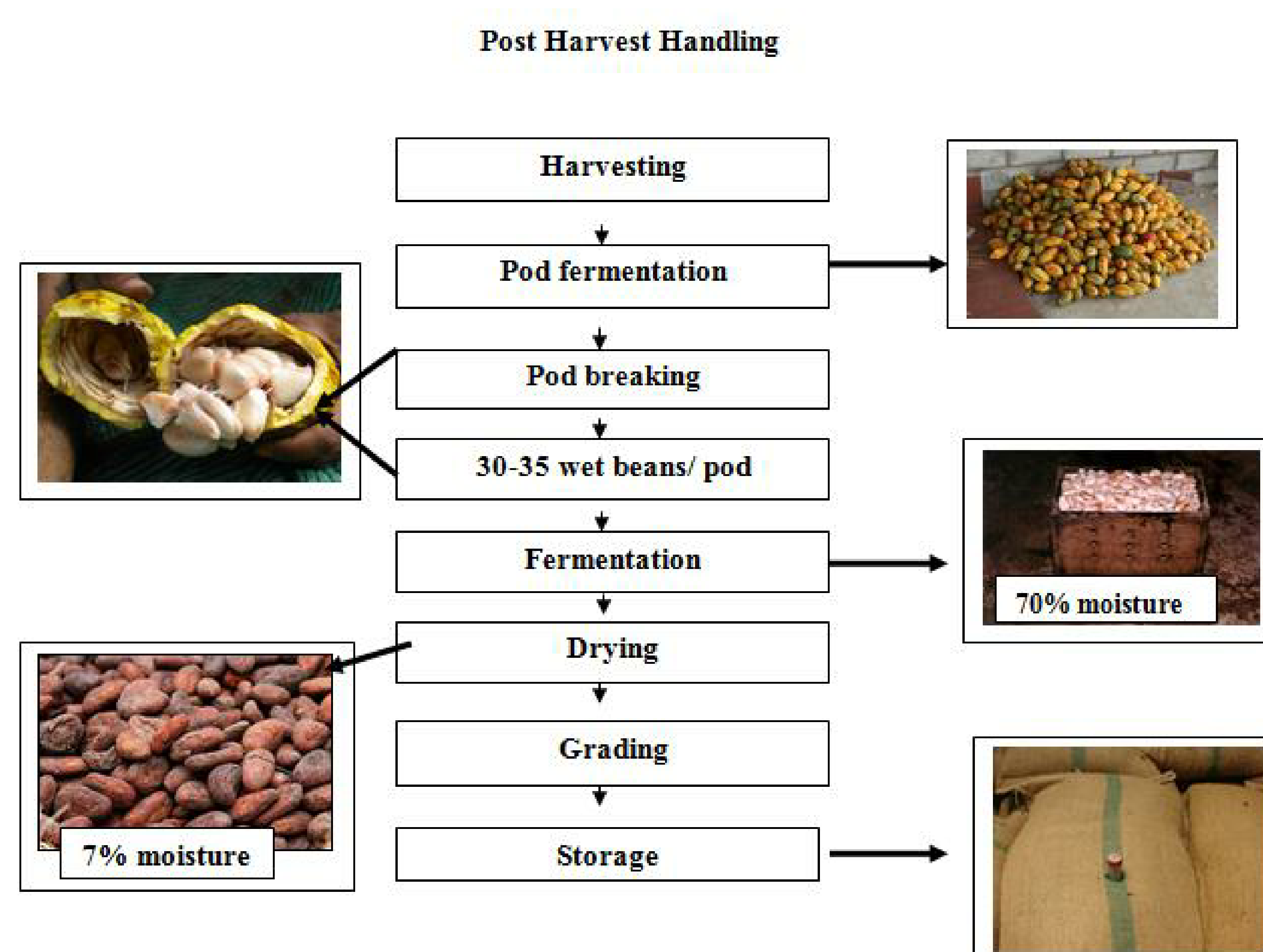
1. Spraying of Neem Oil 3% or fish oil rosin soap 25 g/litre.
2. Spraying of dimethoate @ 2 ml per litre.
3. Spraying Imidacloprid (0.6 ml/lit), Thiamethoxam (0.6 g/litre), Profenophos (2 ml/litre), Carbaryl (2 g/lit).
4. Spray with 1% Bordeaux mixture or 0.2% copper oxychloride just before the onset of monsoon and thereafter at frequent intervals for seedling blight.
5. Remove the infected pods.
6. Remove and destroy the affected seedlings.

Harvest and Threshing

Cocoa trees start flowering from third year of sowing/planting. Actual economic yield starts from fifth year. Cocoa pods mature in about 5 to 6 months. Usually cocoa produces two main crops in a year. Usually, one can judge the maturity of pods by colour change. Generally, green pods turn to yellow when mature. Make sure to harvest at regular intervals of 10-12 days. Do not allow pods to be over ripened. The pods are opened by heating on a hard surface or using a mallet.

Post-Harvest Handling

Once harvesting is done, pod fermentation should be carried out. Afterwards pod breaking should take place in this you may get 30 to 35 wet cocoa beans per each pod. These beans should go through fermentation and drying. Dried cocoa beans should be graded, packed and stored.



Yield

On average 50-70 pods/tree/year.

Betel Leaf

Botanical Name: *Piper betel*.

Family: Piperaceae.

Origin

Betel vine is a perennial dioeciously creeper native of Malaysia.

Importance

Betel vine leaves have a strong pungent aromatic flavour and are widely used as masticatory. Mature leaves are used for chewing with smeared hydrated lime plus catachu, arecanut, clove, cordamom, clove, funnel etc. Betel chewing is considered as a good and cheap source of dietary calcium. Betel

oil has several medicinal used. Leaves has also religious importance.

Variety

Bangla, Mitha, Sanchi, Korpuri, Ujani, Maghi, Deshi, Barisal, Jali, BARI Paan 1, BARI Paan 2, BARI Paan 3.

Climate

Betel leaf grows very well in tropical climate with high rainfall and a shady places are the best for its vigorous growth. It flourishes in areas with a rainfall of 225 to 475 cm.

Soil

Betel Leaf or Paan can be grown in wide range of soils such as sandy loam, heavy clayey loam. Supplementing the soil with good organic matter results best growth and higher yield. Soil should have good drainage as well. Land should be raised by 5 to 10 cm from the adjacent areas.

Land Preparation

Land should be prepared by 4-5 ploughing. Land should providing proper drainage. Afterwards, field beds of sizes (15 cm height and 30 cm wide) are prepared. Soil should be sterilized thoroughly before planting the betel leaf cuttings.

Soil Sterilization

When the soil temperature rises during the months March to May, soil is covered by polyethylene sheets in order to eradicate the inoculum of soil borne pathogens.

Application of neem cake (0.5 tonnes/ha) or carbofuran @ 1.5 kg/ha Plus carbofuran (0.75 kg/ha) is also preferred to minimize early soil nematode population for new betel plantation. However, carbofuran should not be recommended or preferred in established betel plantations at any stage, because a time gap of 65 to 75 days as safe waiting period is mandatory between harvesting of betel leaves and the application.

Planting time

The monsoon season is ideal for planting betel leaves plants under closed system cultivation. However, planting season of betel leaves varies from region to region.

♣ November – December and January – February are optimum for cultivation.

Propagation and Cultivation

In betel leaf propagation, stem cuttings having 3 to 5 nodes are used and these are planted in such a fashion that 2 to 3 nodes are buried in the soil. A single node cutting with a mother betel leaf is also planted. Apical and middle portions cuttings of the betel vine are used for planting. There are 2 types of betel leaf cultivation is practiced in India and Bangladesh.

- 1) Open system cultivation using support plants.
- 2) Closed system cultivation using rectangular structures (artificial) called boroj.

Growing of support plants for natural support and shade

Plants of *Moringa* or *Sesbania* or *Erythrina* are raised to provide support and shade. These support plants are sown in 45 to 60 cm rows at least 45 days before planting the cuttings of betel leaf.

Building rectangular structures for artificial support and shade

Rectangular structures are normally made on slightly sloppy field, near to a source of watering at a higher level than the adjoining place. Make sure to have slopes in all directions for quick water drainage. Boroj are just rectangular structures made up of sticks or bamboo which are normally having a height of 2 to 2.5 meters. These rectangular structures are covered with using straw or coconut leaves or similar kind of material.

Planting of Betel Leaf cuttings

Basically Planting is done in rows and spacing between plants varies region to region. An average spacing is 75 cm to 100 cm. 42,000–75,000 cuttings are planted per hectare under open cultivation system whereas 1,00,000–1,25,000 cuttings per/ha are sufficient in rectangular closed cultivation system.

Manures and Fertilizers

Linseed cake, Oilseed cakes like Castor cake, neem cake or sesamum cake can be applied. The cake is first soaked in water in a big earthen pot for a week or so. Then this slurry is applied at frequent intervals of crop. Oil cakes in powder form can also be applied in the monsoon season.

♦ FYM: 15 Q/ ha/ year.

♦ P_2O_5 : 100 kg/ ha/ year.

♦ N: 200 kg/ ha/ year.

♦ K_2O : 100 kg/ ha/ year.

The manures and fertilizers should be applied in 4 to 6 split doses at 2 to 3 months interval period.

Cultural Operation

Sets establishes within 3 weeks. The first leaf comes within a month. From this time, it requires constant cutting by expert hand. Following operations are required to be carried out-

- 1) Thinning & pruning of leaves.
- 2) Sapfilling.
- 3) Earning-up.
- 5) Irrigation and drainage.

Lowering of Vine

When the vines reach a height of about 3 feet, they not only loose their vitality but also become difficult to harvest. They are often regulated by 'Lowering them'. It is a process in which vines are united from their support & their lower portion coiled and buried in the soil, leaving free only a few

nodes at the growing end. Best time of lowering is summer season. This also, helps in producing more tillers & vigorous growth of vines.

Training and pruning

One month after the plantation of betel leaf, young shoots begin appearing and these are trained along the support and tied with them using jute fiber or banana fiber once in every 2 weeks to 3 weeks.

Irrigation

Since betel vine needs high soil moisture content, frequent light watering is required depending upon the season of the crop. Irrigation should be given on need base and proper drainage should be maintained during rainy season.

Pest & Diseases

▲ Pest: Aphid, mites, Scale insects, Nematode, Mealy bug etc.

▲ Diseases: Foot rot, leaf spot, anthracnose, powdery mildew etc.

Control

- Select well matured (more than 1 year old) seed vines free from pest and diseases.
- Remove the affected vines away from the garden and burn them.
- Application of *Trichoderma viride* @ 5 g/vine.
- Spraying 0.2% Wettable sulphur after plucking the leaves for powdery mildew.
- Soil application of *Bacillus subtilis* (BbV 57) or *Pseudomonas fluorescens* @ 10 g/vine for the control of root knot nematode and quick wilt of betel vine.
- Spraying Malathion 50 EC 1 ml/lit.

Harvesting

Harvesting of leaves starts from 6 months to 18 months after planting depending of soil, varieties; each vine is picked thrice or four times in a year. Expert hands are needed for picking. Artificial nail are also used for picking. The crop yield is less in first year, maximum in middle and less towards. The picked leaves are washed cleaned, counters and sorted in different grades according to size, colour, texture and maturity and their chewing quality.

Yield

An average annual yield of a good betel leaves crop is about 60-75 leaves/plant and 6-7 million leaves/ha. This yield also depends on cultivation methods and variety of betel leaves.

Arecanut/Betel nut

Botanical Name: *Areca catechu*.

Family: Palmae.

Origin: India and South Eastern countries.

The areca nut palm produces the common chewing nut which is popularly known as betel nut or supari. This nut is consumed in very large extent hence has great demand. The areca nut is not a true nut, but rather a fruit categorized as a drupe. It is commercially available in dried, cured and fresh forms.

Variety

No definite variety in Bangladesh. In, Bangladesh local variety are cultivated. It is named by the name of growing place such as Rangpuri, Barisali, Sylheti etc. Recently, Bangladesh Agricultural Research Institute released two hybrid variety. They are known as BARI supari 1, BARI supari 2.

Some Indian varieties are Mangala, Sumangala, Subamangala, Mohitnagar, Srimangala, Samruthi etc.

Climate

- Arecanut is a tropical crop. It is capable of growing under variety of climatic conditions.
- It grows well from sea level upto an altitude of 1000 m in areas of abundant and well distributed rainfall.
- It is grown in high rainfall area about 200 to 400 cm.
- The cultivation is mostly confined to 20° North and South of the Equator.
- It is unable to withstand extremes of temperature and wide diurnal variations. The optimum range of temperature is 15-38°C for its good growth.
- High humidity and areas free from cyclonic wind and sun scorching are congenial.

Soil

The arecanut palm is grown in a variety of soils. The soil also should be deep and well drained. Water logged, soils should be avoided. The depth of soil should be at least 1m with 4.5-7.6 pH. An adequate irrigation facilities are required for its satisfactory production.

Land Preparation

Land should be ploughed and harrowed 2 times to bring the soil to fine tilth stage and make the field weed free from previous crops.

Propagation

It is propagated by seeds. The selection of proper planting material is of almost importance.

Selection of Mother Palms

Select mother palms showing earliness in bearing and high percentage of fruit set. The age of the palm should 20-40 years and have a regular bearing habit. Less than 10 leaves and 4 bunches per year and poor yielding mother trees should be rejected.

Selection of Seed Nuts

Select fully tree ripe nuts for use as seeds. Discard nuts which are undersized, malformed and low in weight.

Raising of Seedlings

Sow selected seed nuts soon after harvest in nursery bed with stalk end up and with a spacing of 5-6 cm. Cover the seed nuts with sand and irrigate daily. Germination starts about 40 days after sowing and the sprouts are ready for transplanting when they are about three months old having 2-3 leaves.

Prepare secondary nursery beds of 150 cm. width and a convenient length. Transplant sprouts at a spacing of 30 X 30 cm with the onset of the monsoon. Partial shade to the seedlings can also be provided by banana, *Coecinia indica* or by means of artificial pandal. Provide irrigation during hot and dry periods and drainage during monsoon. Periodical weeding and mulching are necessary.

Time of Planting

June – December is found to be the good for it's planting.

Selection of Seedlings

Select good seedlings for transplanting in the main field when they are 12-18 months old. Selection of seedlings can be based on Selection Index which is calculated by multiplying leaf number by 40 and subtracting the seedling height.

Example: Seedling height 90 cm. Leaf numbers 5, Selection index $(5 \times 40) - 90 = 110$

Select seedlings with higher Selection Index Values i.e. if index values range between 50 and 150, select seedlings with higher values. Remove seedlings with ball of earth attached to them for transplanting.

Planting

Plant tall, quick growing shade trees on the Southern and Western sides of the seedlings to provide protection from sun scorching. This helps for better stand of crop in the initial stage.

Dig pits of 90 X 90 X 90 cm at 2.7 X 2.7 m and fill up with rich top soil to a level of 15 cm from the bottom. Plant seedlings in the center of pit, cover with soil upto collar and press around. Banana is raised between rows to provide shade to the seedlings in the initial stages upto 4-5 years.

Fertilizer Application

A steady and high yield will depend much on the adequate availability of plant nutrients in the soil. p

The application of fertilizer for adult palm are-

♦ N : 100 g/ palm/ year.

♦ K₂O : 146 gm/ palm/year.

♦ P₂O₅ : 40 g/ palm/ year.

♦ Compost: 12 Kg/ palm/ year.

1. Apply 1/3 dose of fertilizer and full dose of green manure and compost during first year.
2. 2/3 dose of fertilizer and full dose of green manure and compost during second year.
3. Full dose from third year onwards during September – October.

♦ Under irrigated conditions, apply fertilizers in 2 split doses-

- The first during September – October.
- The second during February.

♦ Under rainfed conditions apply the-

- Second dose during March – April after receipt of summer rains.

♦ Apply manure and fertilizers in circular basins of 15-20 cm depth and with a radius of 0.75-1m from the palm. Apply second dose of fertilizer around the base of palm after weeding and mix into soil by light forking.

♦ In acidic soils, broadcast lime @ 0.5 kg per palm once in 2-3 years and incorporate into soil during April – May.

Irrigation and Drainage

Areca nut cannot withstand drought for a long time. Being a perennial crop, once affected by water stress, it may require two-three years to regain the normal vigour and yield. The death of palms due to moisture stress is possible in long drought season.

- Irrigation should be given @ intervals of 4 and 10 days for better growth and yield.
- The quantity of water required is about 175 to 200 lit. per palm/irrigation.

However, in case of areas having water problem can adopt drip irrigation or sprinkler irrigation to overcome the water problem. Drainage channels should be made based on soil type. In heavy soils drainage channels should be dug in each row to drain out the excess water. The channels should be at least 15 cm to 30 cm deeper than the depth at which the palm nut seedlings are planted.

Weed Control

Regular manual weeding tasks should be carried out to make the nut orchard weed free. Weeding is done twice or thrice a year by spade digging. Light forking or digging after cessation of monsoon should be carried out. Remove any dead or diseased palm leaves. Mulching can be done to prevent weed growth and soil erosion, terracing can also be done to prevent soil erosion in sloppy areas. This also helps in retaining the water from evaporation.

Intercropping

Owing to the long pre-bearing age of the palm, practically no income obtained during the first 3-4 years. Black pepper, coffee, vanilla, cocoa, citrus, cinnamon and clove can be cultivated as intercrop in arecanut cultivation.

Pests and Diseases

▲ Pests: Mites, Spindle bug, Inflorescence caterpillars and Nematode are the common pests found in arecanut cultivation.

▲ Diseases: Bud rot disease, Stem breaking, Foot rot, Yellow leaf disease, Leaf spot and Nut crack are the common diseases found in areca nut cultivation.

Control

1. Apply Dust Methyl parathion 20 EC 2 ml/lit or WP @ 2.5 g in one litre of water.
2. Mites can be controlled by spraying Dicofol 18.5 EC @ 2.5 ml/lit.
3. For bud rot, Infected tissues of the bud should be scooped off and treated with 10 % Bordeaux paste.
4. Leaf spot can be reduced by foliar spray with Bordeaux mixture 1% or 0.2% Dithane M 45.
5. Spray Borax 2 g/lit with proper water management for nut crack.

Harvesting

The nut bearing starts after 5 years of planting. The plant is monocious, producing both male and female flowers on the same tree. The spadix of a grown up palm produces on an average 294 female flowers.

The colour of the fruit during its growth changes from green to different shades of yellow and red during ripening. Nut matures after 8-9 months after fertilization. 4-5 spadix are produced by the palm per year. The number of harvesting will vary from 3 to 6 in 1 year depending upon the season and place of cultivation.

Yield

In arecanut cultivation, an average yield of 300 to 400 nuts/palm/year or 1250 kg/ha can be obtained.

Bamboo

Scientific name: *Bambusa* spp.

Family: Poaceae.

Origin: China.

Importance

Bamboo is one of the commercially cultivated crops and this is considered as a "poor man's timber". In Asia, bamboo is the most integrated part of the culture and used as wood substitute. Bamboo is mainly used as construction material, furniture, pulp and plywood. Bamboo shoots are consumed as a food and they are good source of nutrition. There are 33 species of Bamboo found in Bangladesh.

Variety

Sonali, kolsi, Botol, Kali, Rongon, Konchi, Tents, Borua, Budum, Muli, Tolla, Borak, Biazza, Bethua, Farua, Ora, Lota mirtinga etc.

Climate

Bamboo plantation grow well in tropical to warm temperate climatic conditions. However, it does not prefer temperatures under 15°C in summer. As the bamboo has shallow roots & luxuriant growth, there should be a provision of protecting from strong winds. Regions with cold winds are not suitable for its growth as the wind kills the tips of bamboo leaves.

Soil

Bamboo can be grown in wide range of soils except in rocky soils. Bamboo plantation requires well drained sandy loam to clay loam soils with pH range of 4.5 to 6.0.

Land Preparation

The land should be ploughed as thoroughly and deeply as possible. Clearing and ploughing should be done at least 3 weeks ahead of the planting. Provide better drainage system. Bamboo likes water and requires lots of water to do its best, but it does not like to be submerged in water.

Propagation

Generally, Bamboos are propagated through culms cuttings or rhizomes. They can also be propagated through seeds. However, bamboo seeds are very rarely available. Bamboo seedlings are raised on nursery beds and they are allowed to grow in poly pots for a year. Then this seedling will be transplanted into the main field. In rhizome planting method, 1 year age culms with roots should be dug and cut to 1 meter height. These culms should be planted in monsoon (rainy season). If bamboos are propagated through rhizomes, extra care should be taken while planting the rhizomes. In most of the places, vegetative propagation method is practiced.

Planting and Spacing

Usually, bamboo planting is preferred in rainy season. Pits should be dug much before the rainy season and the dug out soil exposed to weathering. The pits size of 60 X 60 cm should be dug and nursery raised seedlings (1 year old) should be planted at distance of 5m X 4m. The density or the number of plants of bamboo accommodated in 1 acre is about 200. A few days before planting thoroughly turn the soil in the pit.

Inter cropping

In bamboo plantation the gestation period is 5 years. The inter space can be used during first 3 years for extra income by cultivating inter crops like ginger, chillies and turmeric. Even any shade loving aromatic or medicinal plants can be grown.

Fertilizer Application

It is better to carry out soil analysis to fix and confirm the dosages. A general dosage normally that may be followed is- (Plant/year).

▲ Urea: 15.5 kg.

▲ SSP: 5.5 kg.

▲ MoP: 13.45 kg.

For first year 50%, second year 75% and third year onwards-full dose should be given in 10 split doses.

Fertilizer application is required to be done first during planting. The fertilizer should be mixed in the pits. Subsequently, fertilizer should be applied every months of planting. Care should be taken to see that chemical fertilizers are not applied directly.

Intercultural Operation

Mulching: The growth of the weeds controlled by mulching apart from retaining the soil moisture. All transplanted plants should be mulched with 20 cm depth of straw or hay and a diameter of 2m. To protect from drying the soil, spread the soil on top of mulch.

Weed Control: Hand weeding and hoeing should be carried out for controlling the weeds. Mulching will also control the weeds. As sun light causes for more weed growth, providing shade on the ground and lowering the temperatures can check out the weeds.

Mounding: Rhizomes grow laterally under the soil surface and when ready to throw up shoots, begin to grow upwardly inclined angle as well. In this period of growth, exposure to sunlight retards and may even stop the growth of rhizomes. Mounding or heaping fresh, loose soil around and over the base of the plant is recommended.

Pruning: In some species there is heavy branching at the lower nodes of the plant. For example *Dendrocalamus hamiltonii* and *Bambusa balcooa*. Pruning of these branches reduces clump congestion and helps provide a healthy, airy environment within the clump. Mild pruning should be done in the second and third years of growth, and intensive pruning from the fourth year onwards. It should be completed before the end of the dormancy period, well before shoots emerge. Pruning should be carried out in the month of December and January.

Cleaning: Generally clump formation starts in third year, the management of clumps are very important. Rhizomes grow centrifugal (outwards) throwing up new shoots in enlarging circular formation. Bamboos can throw up many branches, which if left unattended can get deeply entangled. This not only curbs access to older culms towards the center of culm, but also obstructs free vertical growth of new culms. The new culms may get twisted and turned, which further congest the clump. Such malformed culms make harvesting of the better culms difficult. Therefore, it is important to clean clumps early and to remove all dead and malformed culms. A well aired clump results in the emergence and growth of healthy culms. Dead stems are not only vulnerable to pathogens, but also dry up fast and are a potential fire hazard.

A good time to carry out clump cleaning operations is February – March. In this period of dormancy after the rigors of winter are over and before the cycle of active growth begins again, the plant system is better prepared to withstand the stress of cleaning activities.

Thinning: Thinning the clump is essential from third year onwards to avoid congestion and to ensure proper growth and easy extraction of culms. Weak and deformed culms should not be retained in the culm. An appropriate clump structure should be maintained through thinning as well as through extraction or retention of shoots.

Irrigation

In bamboo planting, irrigation should be carried out frequently while they are grown on nursery beds. Immediate irrigation should be given at the time of transplanting seedlings from nursery to main field. As bamboo trees are sensitive to water logging, make sure to drain out the soil in case of heavy rains or flooding. Subsequent irrigations depend on the soil moisture holding and climatic conditions. It's preferred to let a plant go a little dry and water it. A drip irrigation system can be adopted for better utilization of water. Over watering will make the tips of leaves to turn into brown.

After planting, irrigate with 12-20 litres of water, depending on the prevailing climatic conditions and compact the loose soil around the plant. Repeat the watering the next day. For the next 10 weeks (at daily intervals initially, extending later to once in three days).

Pests and Diseases

Following are the pests and diseases control measures in Bamboo Cultivation. Leaf biting & sucking insects are common pests in young bamboo plantation. Appropriate pesticides should be applied to control these pests.

Main diseases found in bamboo plantation are *Fusarium moniliforme*, var. *intermedium*, *F. equiseti* and culms blight. Appropriate chemical control measures should be taken care to control these diseases.

Harvesting

Harvesting of bamboo culms every year will induce the emergence of new shoots and ensures regular and healthy culm production. In bamboo cultivation, the harvesting can be carried out from 5th year onwards. However, in commercial farming, harvesting should be carried out from 6th year. In the first year of harvest i.e. 6th year, 6 culms/clump can be harvested followed by 7 culms in 7th year, 8 culms in 8th year and 9 culms from 9th year onwards. Generally, the 1 or 2 year old culms are left for regeneration.

Harvesting Time: The best time of the year to harvest culm is in the post monsoon season extending through the winter. This is the period of dormancy during which culms tend to have lower starch content. They are therefore less susceptible to borers, termites and other pests. Culms should not be harvested in the growing season, which is normally during the monsoon months. Harvesting in this period can damage young and emerging shoots and retard the future growth of the clump.

Yield

Generally, the annual yield of bamboo depends on the species and as well as environment. An average weight of culms at 10 kg, the yield in the 1st year is about 9.5 to 10 tonnes/acre which will stabilize at about 14.5 tonnes per acre in 9th year.